



# COMMONWEALTH of VIRGINIA

## DEPARTMENT OF ENVIRONMENTAL QUALITY

W. Tayloe Murphy, Jr.  
Secretary of Natural Resources

### PIEDMONT REGIONAL OFFICE

4949-A Cox Road  
Glen Allen, Virginia 23060  
(804) 527-5020  
Fax (804) 527-5106  
[www.deq.virginia.gov](http://www.deq.virginia.gov)  
December 29, 2005

Robert G. Burnley  
Director

Gerard Seeley, Jr.  
Piedmont Regional Director

King William County  
Central Crossing Subdivision  
Section 1 Gravity Sewers

Jim Duke  
Rodgers – Chenault, Inc.  
7240 Lee Davis Road  
Mechanicsville, Virginia 23111

Dear Mr. Duke:

This Office has received plans and specifications, as prepared by Timmons Group, for the referenced facility. The plans entitled "Central Crossing, Section 1, Acquinton District, King William County, Virginia" contain 10 sheets and are engineer stamp dated December 19, 2005. The plans reference King William standard specifications.

The project consists of construction of 1300 linear feet of 8-inch gravity sewer to serve a 62 unit residential subdivision. The system will be owned by King William County.

The evaluation of these plans and specifications has been confined to technical requirements and design criteria, as stipulated in the Commonwealth of Virginia *Sewage Collection and Treatment Regulations*.

In accordance with Virginia Water Control Law, *Code of Virginia*, 1950 as amended in Title 62.1, Section 62.1-44.19, this letter report is to advise that the previously mentioned plans and specifications are technically adequate and are approved by this office.

One copy of the previously described report with Virginia Department of Environmental Quality approval stickers is enclosed.

King William County  
Central Crossing Subdivision  
Section ! Gravity Sewers

Please be aware that disturbance of any streams and/or wetlands may also require permitting. If you believe that this may be the case, please contact Oula Shehab at the Piedmont DEQ Office, 804-527-5069, for further information on the permitting process.

For the Director, Department of Environmental Quality

Sincerely,



Raymond R. Barrows, Jr., P.E.  
Area Engineer  
Office of Wastewater Engineering

J. R. Bell Jr., DEQ-PRO  
Oula K Shehab, DEQ-PRO  
Reuben Varghese, M.D., M.P.H., Director, Three Rivers Health District  
James C Pyne, Ph.D., P.E., HRSD  
Frank A. Pleva, Administrator, King William County  
Ivan M. Wu, P.E., Timmons Group



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Section 1 Pump Station

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Dear Mr. Duke:

This Office has received plans and specifications, as prepared by Timmons Group, for the referenced facility. The plans entitled "Central Crossing, Section 1, Acquinton District, King William County, Virginia" contain 10 sheets and are engineer stamp dated December 19, 2005. The specifications entitled "Central Crossing, Section 1, Project Manual, Technical Specifications, King William County, Virginia" are engineer stamp dated December 19, 2005.

The project consists of construction of 3300 linear feet of force main and a pump station to serve a 66 unit residential subdivision. The pump station will be equipped with duplex submersible pumps, each rated at 24 gallons per minute at 111 feet TDH. The system will be owned by King William County.

The evaluation of these plans and specifications has been confined to technical requirements and design criteria, as stipulated in the Commonwealth of Virginia *Sewage Collection and Treatment Regulations*.

In accordance with Virginia Water Control Law, *Code of Virginia*, 1950 as amended in Title 62.1, Section 62.1-44.19, this letter report is to advise that the previously mentioned plans and specifications are technically adequate and are approved by this office.

King William County  
Central Crossing Subdivision  
Section ! Pump Station

One copy of the previously described report with Virginia Department of Environmental Quality approval stickers is enclosed.

Please be aware that disturbance of any streams and/or wetlands may also require permitting. If you believe that this may be the case, please contact Oula Shehab at the Piedmont DEQ Office, 804-527-5069, for further information on the permitting process.

For the Director, Department of Environmental Quality

Sincerely,

A handwritten signature in black ink, appearing to read "Raymond R. Barrows, Jr.", written in a cursive style.

Raymond R. Barrows, Jr., P.E.  
Area Engineer  
Office of Wastewater Engineering

J. R. Bell Jr., DEQ-PRO  
Oula K Shehab, DEQ-PRO  
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James C Pyne, Ph.D., P.E., HRSD  
Frank A. Pleva, Administrator, King William County  
Ginastyo Mutoti, P.E., Timmons Group

7/03

Project:

PUMP STATION  
REVIEW FORMPage 1 OF 6  
Date 12/30/03  
Reviewed By: RRBREQUIREMENTREFERENCECOMMENTS

Location of Pump Station \_\_\_\_\_

Central Garage, King William

Buffer zone: \_\_\_\_\_

100' recommended

Station Protected from 100-year flood: 133/132note

Fully operational during 25-year flood: \_\_\_\_\_

note

All-weather access road provided: \_\_\_\_\_

gravelsh 3RECEIVING FACILITIESaccepted by King William / HRSO

Capacity of receiving sewer line \_\_\_\_\_ MGD

Adequate?

Capacity of receiving pump stations \_\_\_\_\_ MGD

Adequate?

Capacity of receiving STW = \_\_\_\_\_ MGD

Adequate?

STP average flow (1 yr.) \_\_\_\_\_ MGD

PRETREATMENTDischarge piping designed to prevent grit from settling  
in lines of pumps not in operation: (Y/N)Briefly describe any pretreatment provided:  
(restaurants must have a grease trap)N/APUMPING UNITSType of Pumps Provided submersible, grinderNumber of pumping units provided: 2

minimum of 2

Pump No.	Friction Head (ft)	Static Head (ft)	Rated Capacity (gpm)	Rated TDH (ft)	Operating Capacity (gpm)	Computed TDH (ft)	Variable Constant Speed
1-2	97	53	45'	162	140	150	G

7/03

Project:

PUMP STATION  
REVIEW FORMPage 2 OF 4  
Date 12/30/05  
Reviewed By: RRB

Central Crossing 1.

STATIC HEAD: -

High point elev:

Pump Off elevation:

RESIDUAL HEAD: -

C =

FRICTION HEAD: -

EQ LENGTH OF PIPE, ft

APPERTENANCE:

see attached

Friction losses:

FLOW (gpm)	RES + STATIC HD (ft)	FRICTION LOSSES (ft)	TDH (ft)	velocity (fps)	loss/100' (ft)

Plot FLOW against TDH on the next page (pump curve).

The pumps will operate at 24 gpm vs. 1'55" feet TDH,  
to 115 gpm vs. 6'6" feet TDH.  
powered by a 10 HP electric motor.

7/03

Project:

PUMP STATION  
REVIEW FORMPage 3 OF 6  
Date 12/30/03  
Reviewed By: RRTREQUIREMENTREFERENCECOMMENTSIs capacity of pumping equipment adequate? (Y/N)Can peak flow be pumped with largest unit  
out of service? (Y/N)

Alternating control: \_\_\_\_\_

Type of control mechanism: float switchControls adequately protected from the weather:  
(inside or NEMA rated: 4X)Junction Box out of Wet Well? yes

Individual suction and intake lines: \_\_\_\_\_

Suction line size \_\_\_\_\_ inches

Velocity (range) in suction line \_\_\_\_\_ fps

Discharge line size 2 inchesVelocity (range) in discharge line 4.5 fps

Are line sizes and velocities adequate? (Y/N)

Is there a limit switch? (Y/N) Velocity range ok? (Y/N)Is gate valve provided on each suction line? (Y/N)Gate valve and check valve on each discharge line? (Y/N)

Size of spheres that pass through pump \_\_\_\_\_ inches

If less than 3 inches, explain: \_\_\_\_\_

spec 13709-1.04sh 4

Adequate?

sh E 1"N/AN/A

4-inch minimum

N/A

2 to 6 fps

OK

2 to 8 fps

45  
2.5" x 2"N/AN/A

both on each line

grinderminimum 3" diameter  
Can pass 2" if a  
≤ 2" bar screen is  
providedSUBMERSIBLE PUMP STATIONS

Provisions for pump quick disconnect &amp; reconnect:

OK

for small stations

Hoist and accessories: sh 4OKShut-off & check valves located in a separate vault? (Y/N)SUCTION LIFT STATIONS

Net positive suction head requirements met? (Y/N)

Gate valve provided on suction line? (Y/N)

Air relief piping on pump discharge line? (Y/N)

min. 1.25" diameter

Pumps, shutoff, &amp; check valves located outside wet well?

7/03

Project:

PUMP STATION  
REVIEW FORMPage 4 OF 6  
Date 12/30/05  
Reviewed By: \_\_\_\_\_REQUIREMENTREFERENCECOMMENTSWET WELL

Is there mechanical equipment/screens which requires personnel to enter the wet well? (Y/N)  
 If "No", is a 4-inch downward-facing, screened vent provided? (N)

If yes, there must be mechanical ventilation

Volume from floor to rim = \_\_\_\_\_ cu. ft. (next page)

Ventilation fan capacity \_\_\_\_\_ cfm

Air changes per hour

(30 air changes/hr minimum for intermittent operation)  
 (12 air changes/hr minimum for continuous operation)

$$\text{air changes/hr} = \frac{\text{fan capacity} \times 60}{\text{volume}} = \frac{(\text{cfm}) \times 60}{(\text{cu. ft.})} =$$

air changes/hr

Is ventilation adequate? (Y/N)

Fan of non-sparking variety? (Y/N)

Adequate access provided? (Y/N)

to pull equipment

Adequate lighting provided? (Y/N)

to work at night

Wet well fillets provided? (N) Slope 1:12:4

minimum of 1:1

Wet well divided? (Y/N)

If "yes", properly interconnected? (Y/N)

Volume between pump off and pump 1 on = 423 gallons11.3<sup>2</sup> . 2 . 7.48

Is design adequate to prevent both pump from overheating due to excessive starts and septic conditions due to excessive detention time? (N)

10 minDRY WELL

Adequate access provided? (Y/N)

Provisions for removing equipment? (Y/N)  
 Describe

Sump pump provided? (Y/N)  
 Discharge point \_\_\_\_\_

Back to wet well  
 and down towards  
 the water level

Volume of dry well = \_\_\_\_\_ cu. ft.

Ventilation fan capacity \_\_\_\_\_ cfm

Air changes per hour

(30 air changes/hr minimum for intermittent operation)  
 (12 air changes/hr minimum for continuous operation)

$$\text{air changes/hr} = \frac{\text{fan capacity} \times 60}{\text{volume}} = \frac{(\text{cfm}) \times 60}{(\text{cu. ft.})} =$$

air changes/hr

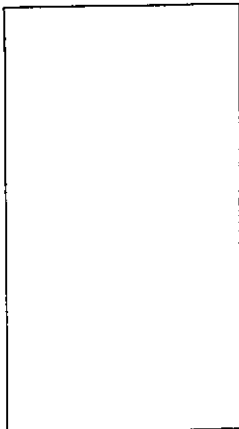


7/03

Project:

Central Crossings 1PUMP STATION  
REVIEW FORMPage 5 OF 5Date 12/30/05Reviewed By: RRB

Wetwell:

Elevations

--Top = 133  
 --Ground = 132

--Inlet = 118.5  
 --Alarm = 118  
 --Lag Pump On = 117.5  
 --Lead Pump On = 117

--Pump Off = 115  
 --Intake = 113.5  
 --Floor = 112

WETWELLA. TOTAL VOLUME:

$$(133 - 112) \cdot 3^2 \cdot \pi \cdot 7.48$$

B. OPERATING VOLUME:

$$(117 - 115) \cdot 3^2 \cdot \pi \cdot 7.48$$

C. ABOVE ALARM VOLUME:

$$(133 - 118.5) \cdot 3^2 \cdot \pi \cdot 7.48$$

CYCLE TIME

1. PUMP TIME =

$$\frac{\text{OPERATING VOLUME}}{\text{PUMP RATE} - \text{MIN. INFLOW}}$$

$$\frac{422}{45 - 5} = 10$$

2. FILL TIME =

$$\frac{\text{OPERATING VOLUME}}{\text{MINIMUM INFLOW}}$$

$$\frac{422}{5} = 85$$

3. CYCLE TIME =

95

4. OVERFLOW TIME

$$= \frac{\text{ABOVE ALARM VOLUME}}{\text{PEAK FLOW IN}}$$

$$\frac{310}{45} = 6.8 \text{ min}$$

NET POSITIVE  
SUCTION HEAD:

Atmospheric Head	(+)	33.9
Vapor Head	(-)	-1.0
Friction Head	(-)	
Suction or Head (+) Lift (-)		
NPSH Available		
NPSH Required		

(NPSH<sub>A</sub> must be > NPSH<sub>R</sub>)SUBMERGENCE:

0/01

Project: Central Crossing 1

PUMP STATION  
REVIEW FORM

Page 6 OF 6  
Date 12/30/05  
Reviewed By: KRM

REQUIREMENT	REFERENCE	COMMENTS
<b>LOW MEASUREMENT (IF PROVIDED)</b>		
Type of measuring device _____	<u>none</u>	
Capacity _____ MGD Properly Sized? (Y/N) _____		
<b>CROSS-CONNECTION CONTROL</b>		
RPZ device on potable water line to pump station? _____	<u>internal</u>	
If "No", explain _____		
Seal water system provided? (Y/N) <u>(Y)</u>		
Adequately protected? (Y/N) _____		
<b>RELIABILITY</b>		
Reliability Class <u>II</u>		
Provision for continuous operability provided? _____		
Describe provision <u>portable pump</u>		
Adequate? (Y/N) <u>(Y)</u>		
Is adequate power distribution provided? <u>(Y/N)</u>		capable of starting the specified pumps
Breaker settings or fuse ratings adequate? <u>(Y/N)</u>		
Electrical control center locations adequate? <u>(Y/N)</u>		inside and be able to see the pump station
Are 3-phase motors adequately protected from short circuits and overloads? <u>(Y/N)</u>		check the phase that is available to the station all pump motors
Low voltage protection for motors? <u>(Y/N)</u>		
Emergency power equipment adequately located? (Y/N) <u>N/A</u>		
Adequate emergency power generator starting system? <u>N/A</u>		battery with a trickle charge or can start three consecutive times
Alarm system provided? <u>(Y/N)</u> <u>phone relay</u>		
Describe _____		
Is the alarm system adequate for the designated reliability class? <u>(Y/N)</u>		
(Class I must monitor main power supply, auxiliary power supply, failure of each pump to discharge, and high liquid level in wet/dry wells; and be equipped with a test function and a back-up power supply. On-site audio-visual alarm required with telemetry to site manned 24 hours per day.) Decibel rating for the audio alarm = _____ decibels at _____ feet.		
(Class II/III must monitor high liquid level in wet well with on-site audio/visual alarm.)		

## Central Crossing 1 Pump Station Design:

### All Pumps Stations Running

Data source: WaterCAD® model

<b>Pump Station Name</b>	<b>Central Crossing 1</b>				
<b>Location</b>	<b>King William County</b>				
<b>Grade Elevation</b>	133.86	ft			
<b>Hundred-Year Flood Elev.:</b>	132.0				
<b>Average Flow</b>	18.0	gpm			
<b>Peak Factor</b>	2.5				
<b>Peak Flow</b>	45	gpm	WaterCAD® uses 24 gpm		
<b>Pump Station Size</b>	0.026	MGD			
<b>Pump Station Capacity</b>	0.065	MGD			
<b>Static Head:</b>	53.50	ft			
<b>High Point Elevation:</b>	168.5	ft			
<b>Pump Off Elevation:</b>	115	ft			
<b>Friction Head:</b>	97.01				
<b>Junction</b>	<b>Diameter</b>	<b>Flow</b>	<b>Forcemain Length</b>	<b>Headloss</b>	<b>Total Friction Headloss</b>
	(in)	gpm	ft	ft/ft	ft
Pump Station Losses	4	24	150	0.002	0.35
J-39 to J-14	6.1	272	2,825	0.0066	18.63
J-14 to J-17	7.9	665	1,540	0.0099	15.10
J-17 to WWTP	9.7	760	13,587	0.0047	62.93
			18,102	0.0054	97.01
<b>Equivalent Forcemain Diameter</b>	9.7	inches			
<b>C- Factor</b>	125	Typical 130, Lower C used to account for fitting losses			
<b>Head Loss at 45 gpm</b>	0.0000249	ft/ft			
<b>Equivalent Velocity in Force Main</b>	0.20	ft/s			
<b>Force main Equivalent Length</b>	3,888,187	ft (Includes pump Station/Appurtenances Headlosses)			
<b>Total Dynamic Head</b>	150.5	ft			

### Central Crossing 1 System Head Curve: All Pump Stations ON

Flow (gpm)	Static Head (ft)	Friction Losses (ft)	TDH (ft)	Velocity (fps)
0	53.50	0.00	53.50	0.00
20	53.50	21.64	75.14	0.09
40	53.50	78.02	131.52	0.17
60	53.50	165.18	218.68	0.26
80	53.50	281.25	334.75	0.35
100	53.50	424.98	478.48	0.43
110	53.50	506.93	560.43	0.48
115	53.50	550.38	603.88	0.50
120	53.50	595.47	648.97	0.52

## Only Central Crossing Pump Station Running

Data source: WaterCAD® model

<b>Pump Station Name</b>	<b>Central Crossing 1</b>				
<b>Location</b>	<b>King William County</b>				
<b>Grade Elevation</b>	133.86	ft			
<b>Hundred-Year Flood Elev.:</b>	132 -'				
<b>Average Flow</b>	46.2	gpm			
<b>Peak Factor</b>	2.5				
<b>Peak Flow</b>	115.4	gpm			
<b>Pump Station Size</b>	0.066	MGD			
<b>Pump Station Capacity</b>	0.166	MGD			
<b>Static Head:</b>	53.50	ft			
<b>High Point Elevation:</b>	168.5	ft			
<b>Pump Off Elevation:</b>	115	ft			
<b>Friction Head:</b>	12.76				
<b>Junction</b>	<b>Diameter</b>	<b>Flow</b>	<b>Forcemain Length</b>	<b>Headloss</b>	<b>Total Friction Headloss</b>
	(in)	gpm	ft	ft/ft	ft
Pump Station Losses	4	115.4	150	0.04280	6.42
J-39 to J-14	6.1	115.4	2,825	0.0014	3.81
J-14 to J-17	7.9	115.4	1,540	0.00039	0.60
J-17 to WWTP	9.7	115.4	13,587	0.00014	1.93
		115.4	18,102	0.000705	12.76
<b>Equivalent Forcemain Diameter</b>		9.7	inches		
<b>C- Factor</b>		125	Typical 130, Lower C used to account for fitting losses		
<b>Head Loss at 45 gpm</b>		0.0001423	ft/ft		
<b>Equivalent Velocity in Force Main</b>		0.50	ft/s		
<b>Force main Equivalent Length</b>		89,640	ft (Includes pump Station/Appurtenances Headlosses)		
<b>Total Dynamic Head</b>		66.26	ft		

# Wastewater Pump Station Calculations

Project: Central Crossing 1  
 Project No: 21776  
 Prepared by: Al and Doc  
 Prepared on: March 30, 2005  
 Date Revised:

## Pump Station Capacity

Description	Value	Units	Notes
Average Daily Flowrate	0.023	MGD	
Calculated Sewer Peak Factor	7.25		Based on $Q_p = 3.5(Q_a^{0.807})$
Calculated Peak Hour Factor	4.13		Based on $\frac{18 + \sqrt{P}}{4 + \sqrt{P}}$ (p=pop. in 1000s)
Calculated Peak Capacity	1.500	MGD	
Peak Factor Used	2.80		
Design Flowrate	45	gpm	
Emergency Force			

## Wet Well Sizing

Description	Value	Units	Notes
Wetwell Diameter	6.00	feet	5' to 6' to provide 50% additional storage
Minimum Pump Cycle	10	min	
Unit Volume	211	gal/ft	
Wet Well Drawdown Volume	113	gal	Based on $V = \frac{TP}{4}$
Minimum Flowrate (VFD Operation)	45	gpm	
Minimum Operating Depth	2.053	ft	
Emergency Force			

## Control Settings

Description	Value	Units	Notes
100-year Flood Plain Elevation	n/a	ft	From FEMA Maps
Top of Wet Well	113.00	ft	From Site Survey
Lowest Invert In	118.50	ft	1 feet of safety included
High Level Alarm	118.00	ft	0.50' Below Influent Line
Lag Pump On	117.50	ft	0.50' Below High Level Alarm
Lead Pump On	117.00	ft	0.50' Below Lag Pump On
Both Pumps Off	115.00	ft	2.00' Below Both Pump Off
Pump entrance diameter	3.00	inches	
Minimum Submergence	0.66	ft	H.I. Stds: $S = (1 + 2.3 F) D$ where $F = v(gD)^{-0.5}$
Suction Entrance Elevation	113.50	ft	1.50' Below Both Pump Off
Wetwell Floor	112.50	ft	12" Below Suction Entrance
Depth of Wet Well	20.50	ft	

## Pump Station Head Loss - Discharge Side

Description	Value	Units	Notes
Pump Station Pipe Diameter	3	inch	
Pump Station Pipe "c" value	120		(Hazen-Williams)
Equivalent Length of Fittings	56.74	ft	From Fitting Friction Loss Table at Right
Straight Pipe Quantity	15	ft	
Total Equivalent Length	71.74	ft	
Pump Station Head Loss	0.58	ft	

# Buoyancy Calculations

Project: Central Crossing 1  
Project No: 21776

Prepared by: Al and Doc  
Prepared on: March 30, 2005  
Date Revised: \_\_\_\_\_

## Wet Well Buoyancy

Description	Value	Units	Notes
Outer Diameter	14.0	ft	
Inner Diameter	6.0	ft	
Depth	20.5	ft	
Concrete Volume	2,576	ft <sup>3</sup>	
Wetwell Weight	373,535	lb	Based on 145 lb/ft <sup>3</sup>
Displaced Volume	3,156	ft <sup>3</sup>	
Buoyancy Force	196,918	lb	
Buoyant Weight of Wetwell	176,618	lbs	Wetwell is not buoyant

## Base Buoyancy Credit

Description	Value	Units	Notes
Base Diameter	14.0	ft	6" Minimum Base Recommended
Base Thickness	1.0	ft	
Concrete / Displaced Volume	154	ft <sup>3</sup>	
Base Weight	22,321	lb	Based on 145 lb/ft <sup>3</sup>
Buoyancy Force	9,606	lb	
Buoyant Weight of Base	12,715	lb	
Buoyant Weight of Structure	189,333	lb	Structure is not buoyant without soil

## Soil Impact

Description	Value	Units	Notes
Angle of Influence	30.0	degrees	
Angle of Influence	0.524	radians	
Top of Triangle	95	ft	
Top Diameter	204	ft	
Bottom Diameter	14	ft	
Saturated Soil Density	110.0	lb/ft <sup>3</sup>	From Geotechnical Report / Estimate
Depth of Soil above Base	164.5	ft	
Volume of Soil	1,897,409	ft <sup>3</sup>	Volume of Soil (frustrum of cone, less wetwell)
Buoyant Weight of Soil	90,316,652	lb	

## Buoyancy Float Check

Description	Value	Units	Notes
Total Difference	176,618	lb	Structure is not boyant